

Amendment to the claims:

Claim 1. (Withdrawn) A method for refining a semiconductor wafer having a semiconductor wafer surface comprising the steps of:

providing at least two refining elements;

holding the semiconductor wafer for refining; and

applying at least two independent operative refining motions to the at least two refining elements and wherein the operative refining motions include at least one electrochemical action during at least a portion of a refining cycle time.

Claims 2-7 (Cancelled)

Claim 8. (Withdrawn) A method for refining a semiconductor wafer having a semiconductor wafer surface comprising the steps of:

providing at least two refining elements;

holding the semiconductor wafer for refining; and

applying at least two different operative refining motions to the at least two refining elements and wherein the operative refining motions include at least one electrochemical action during at least a portion of a refining cycle time.

Claims 9-18 (Cancelled)

Claim 19. (Withdrawn) A method for refining a semiconductor wafer having a semiconductor wafer surface comprising the steps of:

providing at least two refining elements;

holding the semiconductor wafer for refining; and

applying at least two different, independent operative refining motions to the at least two refining elements and wherein the operative refining motions include at least one electrochemical action during at least a portion of a refining cycle time.

20. (Withdrawn) The method for refining according to claim 19 wherein:
- the semiconductor wafer has an assigned tracking code;
 - and before applying at least two different, independent operative refining motions, the method having the additional steps of:
 - providing an operative control subsystem having an operative sensor, a controller, and a processor;
 - and during applying at least two different, independent operative refining motions, the method having the additional steps of:
 - sensing a progress of refining information with the operative sensor;
 - determining a change for at least one control parameter using at least in part at least a process model, the assigned tracking code, information in at least one memory device, and the progress of refining information with the operative control subsystem; and
 - changing in real time the at least one process control parameter which changes the refining.

Claim 21. (Withdrawn) The method according to claim 20 wherein the semiconductor wafer has a low k layer having a k value of at most 3.5.

Claim 22. (Withdrawn) A method of removing an unwanted material from a semiconductor wafer having a tracking code and a semiconductor wafer surface comprising:

- a step (A) providing a refining element having a refining surface and having a first operative electrode;

a step (B) positioning the semiconductor wafer surface with a holder having an operative electrical contact forming a second operative electrode proximate to the refining element;

a step (C) applying an operative refining motion comprising a parallel operative refining motion in the interface between the semiconductor wafer surface being refined and the refining surface of the refining element; and

a step (D) applying refining energy across the first operative electrode and the second operative electrode for electro-refining to remove the unwanted material on the semiconductor wafer surface during at least a portion of a refining cycle time;

a step (E) sensing progress information of the refining of the semiconductor wafer surface with an operative control subsystem having access to a process model and a historical performance;

a step (F) determining at least one improved control parameter using at least in part at least the process model, the tracking code, the historical performance, and the progress information with the operative control subsystem; and

a step (G) controlling in real time the at least one process control parameter to change the refining.

Claim 23. (Withdrawn) The method of claim 22 wherein:

in step (A) the refining element has an identification code;

in step (F) the operative control system has access to the identification code and the determining at least one improved process control parameter comprises using at least in part at least the process model, the tracking code, the historical performance, the refining element identification code, and the progress information with the operative control subsystem;

Claim 24. (Withdrawn) A method for refining comprising:

a step (A) applying a refining energy to a workpiece with a refining element;

a step (B) providing an operative control subsystem having an operative sensor, a controller, and a processor;

a step (C) sensing progress of refining information with the operative sensor during a period of non-steady refining;

a step (D) determining a change for at least one improved control parameter using at least in part at least

- (i) a process model,
- (ii) an assigned workpiece tracking code,
- (iii) information in at least one memory device, and
- (iv) progress of refining information with the operative control subsystem during the period of non-steady refining; and

a step (E) changing in real time the at least one process control parameter which changes the refining during the period of non-steady refining.

Claim 25. (Withdrawn) The method according to claim 24 wherein the step (C), the step (D), and the step (E) are repeated at least 4 times during a single period of non-steady state refining.

Claim 26. (Withdrawn) The method according to claim 24 wherein:

the refining element has a refining element tracking code; and

in step (D) determining a change comprises determining a change for at least one improved control parameter using at least in part at least

- (i) the process model,
- (ii) the assigned workpiece tracking code,
- (iii) the information in at least one memory device,
- (iv) the refining element tracking code; and
- (v) progress of refining information with the operative control subsystem during the period of non-steady refining.

Claims 27-32 (Cancelled)

Claim 33. (Currently amended) A method of refining of a first and a second layer on a semiconductor wafer, each having an effect on the cost of manufacture, the method comprising:

~~a step (1)~~ applying a first refining energy to the first layer of the semiconductor wafer for a first layer refining;

~~a step (2)~~ sensing a real time process information for the first layer of the semiconductor wafer during the first layer refining with an at least one operative sensor for the first layer refining;

~~a step (3)~~ determining an improvement in real time for an at least one ~~improved~~ first layer control parameter "A" using a ~~first-tracking code~~ for the semiconductor wafer and ~~a real the real time progress process~~ information for the first layer of ~~for the~~ semiconductor wafer with an operative control subsystem for the first layer refining; ~~subsystem having the at least one operative sensor~~;

~~a step (4)~~ controlling in real time the at least one first layer process control parameter "A" to change ~~the~~ a first semiconductor wafer surface during the first layer refining of the first layer of the semiconductor wafer;

~~a step (5)~~ storing for future availability stored information related to the at least one first layer process control parameter "A", the ~~first-tracking code~~ for the semiconductor wafer, and the real time ~~progress process~~ information for the first layer of the semiconductor wafer; ~~the first layer refining~~;

~~a step (6)~~ applying a second refining energy to the second layer of the semiconductor wafer having at least one second layer control parameter "B" for a second layer refining;

~~a step (7)~~ sensing a real time process information for the second layer of the semiconductor wafer during the second layer refining with ~~the~~ an at least one operative sensor for the second layer refining;

~~a step (8)~~ determining an improvement in real time for an at least one ~~improved~~ second layer control parameter "B" using at least a portion of the stored

information related to the tracking code for the semiconductor wafer, the ~~first layer~~ real time process progress-information for the first layer of the semiconductor wafer, and the ~~second layer~~ real time process progress information for the second layer of the semiconductor wafer with the an operative control subsystem for the second layer refining; and
~~a step (9)~~ controlling in real time the at least one second layer process control parameter "B" to change ~~the~~ a second semiconductor wafer surface during the second layer refining of the second layer of the semiconductor wafer; and
using an at least one process model and using predictive control during the method.

Claim 34. (Currently amended) The method according to claim 33 wherein ~~the step (4)~~ controlling in real time the at least one first layer process control parameter "A" comprises controlling in real time the at least one first layer process control parameter "A" to change ~~the~~ a removal of material from the first semiconductor wafer surface during the refining of the first layer of the semiconductor wafer.

Claim 35. (Currently amended) The method according to claim 33 wherein ~~the step (1)~~ of applying the first refining energy comprises applying at least two independent refining energies.

Claim 36. (Currently amended) The method according to claim 33 wherein ~~the step (1)~~ of applying the first refining energy comprises applying at least two different refining energies.

Claim 37. (Currently amended) The method according to claim 33 wherein ~~the step (1)~~ of applying the first refining energy comprises applying at least two different, independent refining energies.

Claim 38. (Currently amended) The method according to claim 33 wherein ~~the step (1)~~ of applying the first refining energy comprises applying at least one electrochemical energy for removing material from the first semiconductor wafer surface.

Claim 39. (Cancelled) The method according to claim 33 wherein the step (1) of applying the first refining energy comprises applying at least one electrochemical energy for adding material to the first semiconductor wafer surface.

Claim 39. (Cancelled) The method according to claim 33 wherein the step (9) of controlling in real time the at least one second layer control parameter "B" comprises controlling in real time the at least one second layer process control parameter "B" to change the a removal of material from the second semiconductor wafer surface during the refining of the second layer of the semiconductor wafer.

Claim 40. (Currently amended) The method according to claim 33 wherein ~~the step (6)~~ of applying the second refining energy comprises applying at least two independent refining energies.

Claim 41. (Currently amended) The method according to claim 33 wherein ~~the step (6)~~ of applying the second refining energy comprises applying at least two different refining energies.

Claim 42. (Currently amended) The method according to claim 33 wherein ~~the step (6)~~ of applying the second refining energy comprises applying at least two different, independent refining energies.

Claim 43. (Currently amended) The method according to claim 33 wherein ~~the step (6)~~ of applying the second refining energy comprises applying at least one electrochemical energy for removing material from the second semiconductor wafer surface.

Claim 44. (Currently amended) The method according to claim 33 wherein ~~the step (6)~~ of applying the second refining energy comprises applying at least one electrochemical energy for adding material to the second semiconductor wafer surface.

Claim 45. (Currently amended) The method according to claim 33 wherein:
~~the step (4)~~ controlling in real time the at least one first layer process control parameter "A" comprises controlling in real time the at least one first layer process control parameter "A" to change ~~the~~ a removal of material from the first semiconductor wafer surface during the refining of the first layer of the semiconductor wafer; and
~~the step (9)~~ of controlling in real time the at least one second layer process control parameter "B" comprises controlling in real time the at least one second layer process control parameter "B" to change ~~the~~ a removal of material from the second semiconductor wafer surface during the refining of the second layer of the semiconductor wafer.

Claim 46. (Currently amended) The method according to claim 33 wherein:
~~the step (1)~~ of applying the first refining energy comprises applying at least two independent refining energies; and
~~the step (6)~~ of applying the second refining energy comprises applying at least two independent refining energies.

Claim 47. (Currently amended) The method according to claim 33 wherein:

~~the step (1) of applying the first refining energy comprises applying at least two different refining energies; and~~

~~the step (6) of applying the second refining energy comprises applying at least two different refining energies.~~

Claim 48. (Currently amended) The method according to claim 33 wherein:

~~the step (1) of applying the first refining energy comprises applying at least two different, independent refining energies; and~~

~~the step (6) of applying the second refining energy comprises applying at least two different, independent refining energies.~~

Claim 49. (Currently amended) The method according to claim 33 wherein:

~~the step (1) of applying the first refining energy comprises applying at least one electrochemical energy for removing material from the first semiconductor wafer surface; and~~

~~the step (6) of applying the second refining energy comprises applying at least one electrochemical energy for removing material from the second semiconductor wafer surface.~~

Claim 50. (Currently amended) The method according to claim 33 wherein:

~~the step (1) of applying the first refining energy comprises applying at least one electrochemical energy for adding material to the first semiconductor wafer surface; and~~

~~the step (6) of applying the second refining energy comprises applying at least one electrochemical energy for adding material to the second semiconductor wafer surface.~~

Claim 51. (Withdrawn) A magnetic refining element comprising:

at least one magnetically responsive refining member having at least one electrode;
at least one refining surface; and
wherein the magnetic refining element has an identification code.

Claim 52. (Withdrawn) The magnetic refining element of claim 51 wherein the at least one magnetically responsive refining member has at least two electrodes.

Claim 53. (Withdrawn) The magnetic refining element of claim 51 wherein the at least one magnetically responsive refining member has at least two different refining surfaces.

Claim 54. (Withdrawn) The magnetic refining element of claim 51 wherein the refining surface comprises at least in part a finishing surface free of abrasive particles.

Claims 55-60 (Cancelled)

Claim 61. (Withdrawn) An apparatus for refining comprising:

at least one magnetically responsive refining element having a tracking code;
a refining element placement arm having a electromagnet for lifting, placing, and releasing the magnetically responsive refining element; and
an operative sensor to sense the tracking code; and an operative controller to control the refining element placement arm for lifting, placing, and releasing the magnetically responsive refining element.

Claim 62. (Cancelled)

Claim 63. (Withdrawn) The apparatus according to claim 61 wherein:

the at least one magnetically responsive refining element comprises at least two magnetically responsive refining elements and the at least two magnetically

responsiv refining elements have at least two different refining element tracking codes;

and the apparatus further comprises:

at least two magnetic driving elements;

an operative control subsystem having an operative sensor, a controller, and a processor and wherein the processor has access to the at least two different refining element tracking codes; and

wherein the processor has access to a processor readable media having processing instructions which use the at least two different refining element tracking codes to determine a change for at least one control parameter during a refining cycle time.

Claims 64-65 (Cancelled)

Claim 66. (Withdrawn) The apparatus according to claim 63 wherein the processing instructions include controlling the at least two magnetically responsive refining elements with different, independent refining motions during at least the refining cycle time.

Claim 67. (Withdrawn) An apparatus for refining a workpiece surface comprising:
at least two refining elements having at least two different identification codes;
at least two driving mechanisms for at least two refining motions for the at least two refining elements during at least a portion of the refining cycle time;
a holder for a workpiece which exposes the workpiece surface for refining; and
an operative control subsystem having an operative sensor, a controller, and a processor and wherein the processor has access to the at least two different refining element identification codes and wherein the processor has access to a processor readable media having processing instructions which use at least in part the at least two

different refining element identification codes to determine a change for at least one control parameter during a refining cycle time.

Claims 68-75 (Cancelled)

New claims:

Claim 76. (New) The method according to claim 33 wherein using an at least one process model comprises using at least in part a first principles process model and at least in part an empirically based process model for process control during the method.

Claim 77. (New) The method according to claim 76 additionally comprising:
using a manufactured article having a processor readable medium with processor readable instructions for performing the method of claim 76.

Claim 78. (New) The method according to claim 33 wherein using an at least one process model comprises using at least in part a first principles process model and at least in part an empirically based process model for process control during the method; and wherein the semiconductor wafer comprises a semiconductor wafer having a diameter of at least 300 millimeter; and additionally comprising:
using a refining element having a refining element identification code during the method.

Claim 79. (New) The method according to claim 78 additionally comprising:
using a manufactured article having a processor readable medium with processor readable instructions for performing the method of claim 78.

Claim 80. (New) The method according to claim 37 wherein using an at least one process model comprises using at least in part a first principles process model for process control during the method.

Claim 81. (New) The method according to claim 80 additionally comprising:
using a manufactured article having a processor readable medium with processor
readable instructions for performing the method of claim 80.

Claim 82. (New) The method according to claim 38 wherein using an at least one process
model comprises using at least in part a first principles process model and at least in
part an empirically based process model for process control during the method; and
wherein the semiconductor wafer comprises a semiconductor wafer having a diameter of
at least 300 millimeters.

Claim 83. (New) The method according to claim 48 wherein using an at least one process
model comprises using at least in part a first principles process model for process control
during the method.

Claim 84. (New) The method according to claim 83 additionally comprising:
using a manufactured article having a processor readable medium with processor
readable instructions for performing the method of claim 83.

Claim 85. (New) The method according to claim 48 wherein using an at least one process
model comprises using at least in part a first principles process model; and additionally
comprising:
using a refining element having a refining element identification code during the method.

Claim 86. (New) The method according to claim 85 additionally comprising:
using a manufactured article having a processor readable medium with processor
readable instructions for performing the method of claim 85.

Claim 87. (New) The method according to claim 49 wherein using an at least one process
model comprises using at least in part a first principles process model; and

wherein the semiconductor wafer comprises a semiconductor wafer having a diameter of at least 300 millimeters.

Claim 88. (New) The method according to claim 87 additionally comprising:
using a manufactured article having a processor readable medium with processor readable instructions for performing the method of claim 87.

Claim 89. (New) The method according to claim 50 wherein using an at least one process model comprises using at least in part a first principles process model; and
wherein the semiconductor wafer comprises a semiconductor wafer having a diameter of at least 300 millimeters.

Claim 90. (New) The method according to claim 89 additionally comprising:
using a manufactured article having a processor readable medium with processor readable instructions for performing the method of claim 89.

Claim 91. (New) The method according to claim 33 wherein at least one of applying a first refining energy or applying a second refining energy comprises applying an at least one electrochemical energy for adding material and wherein the semiconductor wafer comprises a semiconductor wafer having a low-k layer having a k value of at most 3.0; and wherein using an at least one process model comprises using at least in part a first principles process model for process control during the method

Claim 92. (New) The method according to claim 33 wherein at least one of applying a first refining energy or applying a second refining energy comprises applying an at least one electrochemical energy for removing material and wherein the semiconductor wafer comprises a semiconductor wafer having a low-k layer having a k value of at most 3.0; and wherein using an at least one process model comprises using at least in part a first principles process model for process control during the method.

Claim 93. (New) The method according to claim 92 wherein applying the first refining energy comprises applying at least two different independent refining energies or wherein applying the second refining energy comprises applying at least two different independent refining energies.

Claim 94. (New) The method according to claim 93 additionally comprising:
using a manufactured article having a processor readable medium with processor readable instructions for performing the method of claim 93.

Claim 95. (New) The method according to claim 33 wherein using an at least one process model comprises using at least in part a first principles process model for process control during the method and wherein the semiconductor wafer comprises a semiconductor wafer having a low-k layer having a k value of at most 3.0; and additionally comprising:
using a refining element having a refining element identification code during the method.

Claim 96. (New) The method according to claim 95 additionally comprising:
using a manufactured article having a processor readable medium with processor readable instructions for performing the method of claim 95.

Claim 97. (New) The method according to claim 33 wherein at least one of applying a first refining energy and applying a second refining energy comprise applying at least one electrochemical energy for adding material and applying at least one electrochemical energy for removing material and wherein the semiconductor wafer comprises a semiconductor wafer having a low-k layer having a k value of at most 3.0; and wherein using an at least one process model comprises using at least in part a first principles process model for process control during the method.

Claim 98. (New) The method according to claim 97 additionally comprising:

using a manufactured article having a processor readable medium with processor readable instructions for performing the method of claim 97.

Claim 99. (New) The method according to claim 97 additionally comprising:
data mining the stored information.

Claim 100. (New) The method according to claim 33 wherein applying the first refining energy comprises applying at least two different independent electrochemical refining energies and wherein applying the second refining energy comprises applying at least two different independent electrochemical refining energies and wherein the semiconductor wafer comprises a semiconductor wafer having a low-k layer having a k value of at most 3.0 and wherein using an at least one process model comprises using at least in part a first principles process model for process control during the method.

Claim 101. (New) The method according to claim 100 additionally comprising:
using a manufactured article having a processor readable medium with processor readable instructions for performing the method of claim 100.

Claim 102. (New) The method according to claim 100 additionally comprising:
data mining the stored information.

Claim 103. (New) The method according to claim 33 wherein the semiconductor wafer comprises a semiconductor wafer having a low-k layer having a k value of at most 3.0; and wherein using an at least one process model comprises using at least in part a first principles process model for process control during the method.

Claim 104. (New) The method according to claim 103 additionally comprising:

using a manufactured article having a processor readable medium with processor readable instructions for performing the method of claim 103.

Claim 105. (New) The method according to claim 103 additionally comprising:
data mining the stored information.

Claim 106. (New) The method according to claim 33 wherein the semiconductor wafer comprises a semiconductor wafer having a low-k layer having a k value of at most 3.0; and wherein using an at least one process model comprises using at least in part a first principles process model and at least in part an empirically based process model for process control during the method; and additionally comprising:
using a refining element having a refining element identification code during the method.

Claim 107. (New) The method according to claim 106 additionally comprising:
using a manufactured article having a processor readable medium with processor readable instructions for performing the method of claim 106.

Claim 108. (New) The method according to claim 106 additionally comprising:
data mining the stored information.

Claim 109. (New) The method according to claim 33 wherein the semiconductor wafer has a diameter of at least 300 millimeters and wherein the semiconductor wafer has a low-k layer having a k value of at most 3.0; and additionally comprising:
changing cost of manufacture by an appreciable amount.

Claim 110. (New) The method according to claim 109 additionally comprising:

using a manufactured article having a processor readable medium with processor readable instructions for performing the method of claim 109.

Claim 111. (New) The method according to claim 33 wherein using an at least one process model comprises using at least in part a first principles process model and at least in part an empirically based process model for process control during the method; and additionally comprising:
changing cost of manufacture by an appreciable amount.

Claim 112. (New) The method according to claim 111 additionally comprising:
using a manufactured article having a processor readable medium with processor readable instructions for performing the method of claim 111.

Claim 113. (New) The method according to claim 33 wherein using an at least one process model comprises using at least in part a first principles process model and at least in part an empirically based process model for process control during the method and wherein the semiconductor wafer has a diameter of at least 300 millimeters and wherein the semiconductor wafer has a low-k layer having a k value of at most 3.0 and additionally comprising:
changing cost of manufacture by an appreciable amount.

Claim 114. (New) The method according to claim 113 additionally comprising:
using a manufactured article having a processor readable medium with processor readable instructions for performing the method of claim 113.

Claim 115. (New) The method according to claim 113 additionally comprising:
data mining the stored information.